# Data Center Energy Efficiency Workshop

**Casuarina Hall,**
**India Habitat Center,**
**New Delhi**

**January 24th ,**
**2008**

USAID
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ECO III

ENERGY IS LIFE
BEE
CONSERVE IT

**USAID Data Center Energy Efficiency Workshop**

# ENSURING GLOBAL COMPETITIVENESS OF INDIAN IT SECTOR BY IMPROVING ENERGY EFFICIENCY OF INDIAN DATA CENTERS

Thursday, 24th January 2008. India Habitat Centre, New Delhi

**DRAFT AGENDA**

09:00 – 09:30 **Registration**

09:30 – 11:00 **Inaugural Session**

a) Welcome Address: Dr. Satish Kumar, COP, ECO III Project
b) About ECO III Project: USAID
c) National Program on Data Center Energy Efficiency: BEE
d) Industry Perspective on Greening of the IT Sector: Mr. Som Mittal, Chairman, NASSCOM
e) Energy Efficiency in High Tech Buildings: Mr. Dale Sartor, LBNL
f) Topic to be decided: CII

11:00 – 11:15 **Tea/coffee Break**

11:15 - 12:45 **Technical Session I**

a) Setting the Context for Data Center Energy Efficiency: Satish Kumar
b) Project Big Green for Data Centers: Sanjeev Gupta, IBM
c) Dynamic Smart Cooling: Mr. M. Mohandas HP
d) Questions & Answers

12:45 – 2:00 **Lunch**

2:00. – 3:30 **Technical Session II**

a) International Best Practices in Data Centers Design and Operation: Mr. Dale Sartor, LBNL
b) Power Density & Efficiency Optimization of existing Low Density Datacenters: Anand Vanchi and Sujith Kannan, Intel
c) Data Center Case Study: Hot and Cold Aisle Technology: Mr. S. Ramu, Network Appliances
d) Questions & Answers

3:30 – 3:45 **Tea/coffee Break**

3:45 - 5:15 **Panel Discussion and Interactive Session**

a) Objective: Develop a Strategy for Producing a Best Practices Guide for Data Centers
b) Moderator: Dale Sartor, LBNL
c) Panelists From: BEE, USAID, CII, IBM, HP, NetApp, Intel.

5:15 – 5:30 **Summary and Next Steps: Dr. Satish Kumar**

# ENSURING GLOBAL COMPETITIVENESS OF INDIAN IT SECTOR BY IMPROVING ENERGY EFFICIENCY OF INDIAN DATA CENTERS

January 15, 2008

## INTRODUCTION

Facilities for high-tech industries (cleanrooms and data centers) are very energy intensive, and operate continuously (24 x 7). These facilities generally consume many times the energy of a typical office building - as much as a hundred times more on a square-meter basis. High-tech facilities are experiencing significant growth in India, making this one of the fastest growing energy-use sectors and impacting electrical supply and distribution. To make situation even more acute, many data centers in India are working on 100% backup power (typically electricity produced by diesel generator sets) to satisfy power requirements that exceeds 10-20 MW. Both economic development and energy program goals can be served by initiatives that reduce energy costs for existing and prospective facilities, and mitigate the impact of high-tech development on electrical infrastructure. High tech facilities contain specialized and complex systems, yet numerous efficiency improvements are possible. Prior energy efficiency efforts have typically been limited to conventional building measures, leaving out the more energy intensive opportunities.

## OBJECTIVES

1) **Help create a public-private partnership to assist in market transformation and capacity building for energy efficiency in Indian IT/ITES infrastructure (cleanrooms and data centers), starting with data centers.**
2) **Transfer international best practices and benchmarks in the design, construction, operation and maintenance of data centers.**

## PLANNED TASK ACTIVITIES (JANUARY 18TH – 25TH, 2008)

1) Walk-through two or three data center facilities in two cities including informal discussions with operations and maintenance (O&M) staff and designers
   a) Discuss measurement plan and benchmarking (using existing and new metering)
2) Meetings with Indian experts (integrated with walk-throughs)
3) Charrette-type meeting with key stakeholders, technology solutions provider, and integrators
4) In conjunction with local experts, prepare presentation material on energy efficiency in data centers tailored for India (overview of opportunities in data centers based on observations and discussions, sharing of best practices and lessons learned from international experience)
5) Concluding Workshop (for a wider audience) titled "**Ensuring Global Competitiveness of Indian IT sector by Improving Energy Efficiency of Indian Data Centers**"
6) Future activity includes developing a best practice manual under the public-private partnership.

## KEY PARTNER ORGANIZATIONS

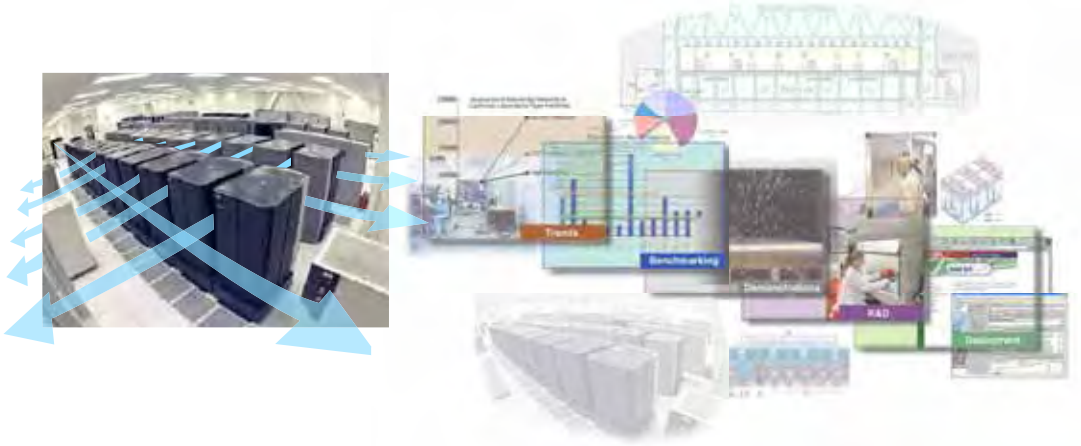
1) **Project Partners**: Bureau of Energy Efficiency, Lawrence Berkeley National Laboratory, US Department of Energy, Confederation of Indian Industry (CII)
2) **Industry Partners**: NASSCOM, IBM, Intel, HP, Network Appliances, Wipro Technologies
3) **Implementing Projects**: USAID ECO-III Project and Asia Pacific Partnership (APP)

# High-Performance Data Centers

*Past Accomplishments and Future Directions*

http://hightech.lbl.gov/datacenters.html

*Mission: Improve the energy performance of data centers, working in close partnership with industry*



## Performing R&D and Technology Assessments

- RD&D roadmap for California Energy Commission, with extensive input from industry
- Categorized server power supplies and Uninterruptible Power Supplies (UPS) by type, identified the energy savings opportunity, developed standardized efficiency testing protocols, measured efficiencies across a range of load conditions, and proposed a labeling criteria for UPS systems
- Developed metrics that can be employed by buyers, manufacturers, and utilities to accelerate implementation of efficiency in data centers
- Researched power losses in standby generation equipment

## Benchmarking Performance

- Data center owners and operators rarely know how their operating costs compare to similar facilities. Benchmarks provide this measure of performance, helping personnel to identify potential cost-saving opportunities. LBNL has benchmarked 22 data centers.

## Developing Tools and Best Practices for Design & Operation

- Extensive template for use in the LBNL design intent tool
- Total-cost-of-ownership tool for uninterruptible power supplies
- Best Practices Guidelines providing first-generation recommendations
- Self-benchmarking protocol for use by facility owners/operators
- Excel-based calculators to estimate energy savings from converting an alternating-current (AC)-based powering architecture to a direct-current (DC) architecture, and improving the efficiency of any one or more of the elements (UPS, AC-DC and DC-DC power distribution) involved in powering a rack of servers

## Making the Business Case

- White paper entitled "High-Tech Means High-Efficiency", coauthored with representatives from AT&T and Critical Facilities Associates, Genentech, and SEMATECH. Companion article in *Forbes*.
- Extensive technology transfer and communications activities, including frequent publications in trade press.
- Clarifying the role of the internet in overall electricity demand trends

**continued on reverse**

## PARTNERS

### Private Industry:

- Alindeska Electrical
- AMD
- APC
- AT&T
- Baldwin Technologies
- Bank of America
- Cisco Systems
- Cupertino Electric
- Dranetz-BMI
- Earthlink
- Ecos Consulting
- Emerson Network Power
- EPRI Solutions
- Equinix
- EYP Mission Critical Facilities
- The Gap
- Hewlett-Packard
- IBM
- IEM (elect. Mfg.)
- Kaiser Permanente
- Network Appliance
- Nextek Power Systems
- Oracle
- Pentadyne
- Rosendin Electric
- Rumsey Engineers
- Satcon Power Systems
- Square D
- Sybase
- Sun Microsystems
- Universal Electric
- Uptime Institute
- 365 Main

### Government:

- IRS
- Naval Postgraduate School
- Franchise Tax Board
- LBNL - NERSC
- US Postal Service

## ADVISORY COMMITTEE

- Ancis
- AT&T
- E Source
- Emerson Electric
- EYP Mission Critical Facilities
- Georgia Tech
- Hewlett Packard
- Intel
- Network Appliance
- Oracle
- PG&E
- Sempra Utilities
- SCE
- Syska and Hennessy
- Uptime institute
- PSMA
- NYSERDA

## Demonstrating Innovation in Real-World Projects

- LBNL orchestrated a unique demonstration of DC powering at Sun Microsystems including active participation of several dozen companies. Data centers include multiple conversions back and forth between AC and DC with large energy losses. Achieved 10-15% facility-wide energy savings compared to best-of-class data centers, improved reliability and first-cost savings.
- In most cases, air-based cooling in data centers involves inefficient mixing of cooled air with air heated by the computer equipment. LBNL demonstrated that large energy savings are possible by isolating the cold and hot airstream, in LBNL's Oakland Scientific Facility housing the National Energy Research Scientific Computing (NERSC) supercomputers.
- Common concerns about using outside-air economizers in data centers are that contamination levels would increase and cause failures of computer equipment or that humidity control would be a problem. LBNL is addressing these by measuring contamination and humidity levels in eight centers including some which use outside air.

## Building Capacity: Consumer Information & Training, and Technical Assistance

- Self-paced training website, introducing users to benchmarking, best practices, and design-intent documentation
- Presentations to facility operators and service providers at numerous workshops and seminars

## Future Directions for Market Transformation—Data Centers for the 21st Century

- **Market assessment**—characterize existing market, barrier identification, and savings potentials
- **Outreach programs**, training, technical assistance, tools and resources (e.g. case studies and best practice guides patterned after the successful Laboratories for the 21st Century Program)
- Energy-efficient **technology development**:
  - IT equipment power supplies
  - Uninterruptible power supplies
  - Dynamic computational-load-based server controls
  - Advanced air-management techniques for efficient data center cooling
  - Demonstrate and test emerging cooling solutions (e.g. liquid cooling) at the component, rack and row level
- Pilot **full-scale installations of DC power** in operating data centers; develop consensus for distribution voltage; develop standard connectors and power strips for DC
- Extend **benchmarking** nationally—identify best practices and trends in patterns of energy use
- Research **failure mechanisms** and mitigation to support use of outside air cooling; ASHRAE collaboration
- Develop **performance metrics** for additional computer benchmark programs
- Develop **LEED-type criteria** to rate the energy and environmental performance of data centers
- Develop **Energy Star** levels for data centers and their components
- **Support utilities** in developing and promoting emerging technologies and deploying incentive programs
- Develop **commissioning** protocols and demonstrations
- Develop energy efficient **high-performance computing**, e.g. DOE super computers
- Extend lessons learned to **overseas markets**

## Sponsors

Our sponsors include the California Energy Commission's Public Interest Energy Research (PIER) Program, Pacific Gas and Electric (PG&E) Company, New York State Energy Research and Development Authority (NYSERDA), U.S. Environmental Protection Agency, and U.S. Department of Energy—FEMP

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# ENERGY CONSERVATION AND COMMERCIALIZATION - PHASE III (ECO-III)

*Version 2.0 (1st December 2007)*

*Energy Conservation and Commercialization (ECO) Bilateral Project Agreement was signed between the Government of India and the United States in January 2000 with the objective to enhance commercial viability and performance of Indian energy sector, and also promote utilization of clean and energy-efficient technologies in the sector.*

## Background

India currently ranks sixth in the world in terms of primary energy demand. As per the Planning Commission's Integrated Energy Policy Report (August 2006), if India perseveres with sustained economic growth rate of 8 % of GDP per annum through 2031-32, its primary energy supply will need to grow by 3 to 4 times, and electricity generation capacity by 5 to 6 times of the capacity in the year 2003-04. It is estimated that by 2031-32, the country's power generation capacity would have to be increased to 800,000 MW from a current level of 160,000 MW inclusive of all captive power plants. In other words, this implies a capacity addition of about 500 MW per week for the next 25 years. This extraordinary growth in energy demand will place great stress on physical and economic resources of the country, which may create capital and energy shortages as well as environmental problems.

Rapid economic growth has been accompanied by commensurate growth in the demand for energy services that is increasing the country's vulnerability to energy supply disruptions. The Ministry of Power (MoP) had set a target of adding 100,000 MW of generation capacity between 2002-12. This programme included a target of 41,110 MW capacity addition in the 10th Plan (2002-07) ending 31st March 2007. However the Working Group on Power for 11th Plan (2007-12) constituted by MoP, estimated a capacity addition of approximately 31,000 MW during the 10th plan, with electricity shortages of about 8.8% of the requirement, while power shortage of 14 % of the peak demand. These vulnerabilities need to be addressed by adopting appropriate policies and programmes to accelerate capacity addition in all the three sectors (Central, State and Private), enhancement of power generation through cogeneration systems in industries as well as through renewable energy sources, and reduction of intensity of energy use in all the sectors of Indian economy through energy efficiency.

## ECO Program

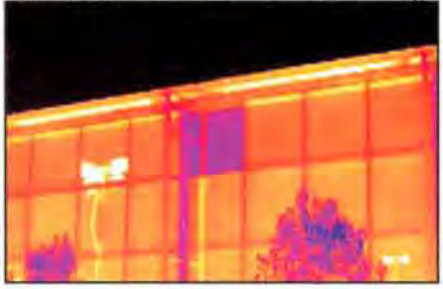
Following the enactment of the Energy Conservation Act 2001, ECO-I supported Goverment of India in the establishment

High Performance Envelope Design

India's First Platinum Rated Green Building

India's Booming Construction Sector

Building Integrated Photovoltaics



Infrared Imaging of Building Facade

Example of Double and Dynamic Enclosure

## Activities Under ECO-III

The third phase of ECO Program which is built on the earlier phases, aims to develop the framework for institutionalizing energy efficiency at the state level, assist implemention of energy conservation building code, enhance energy efficiency initiatives in buildings, municipalities, and in SMEs, promote institutional capacity development, and coordinate energy efficiency projects and actvities between India and the United States.

The Focus Areas of the on-going ECO-III Program are as under:

1. **Assist BEE in the implementation of the Energy Conservation Act, by undertaking following activities:**
   - Development of Energy Conservation Action Plan in the state of Gujarat and Punjab through a strategic partnership with Gujarat and Punjab Energy Development Agency;
   - Implementation of Energy Conservation Building Code (ECBC) with special emphasis on capacity building in the field of envelope design and energy modeling;
   - Promote energy efficiency in existing buildings and municipalities by working with State Road and Building department and Gujarat Urban development Company;
   - Conduct techno-feasibility analysis to identify cross-cutting technologies and replicable energy conservation measures in 2-3 SME clusters in Gujarat and Punjab

2. **Support the development of institutional capability by**
   - Establishing Regional Energy Efficiency Centers to promote technology development and demonstration, facilitate public-private partnership, and create public awareness on energy efficiency;
   - Promoting the delivery of energy services to facilitate implementation of energy efficiency projects;

3. **Assist in the development and inclusions of energy efficiency and building science related topics in architectural curriculum by**
   - Developing architectural and engineering courses (building science and energy modeling) and select architectural/engineering schools for pilot testing of these courses;
   - Making available in the public domain the technical resources developed under the project, and identify high quality references for reprinting in India for easier and wider availability at academic institutes;

4. **Facilitate Outreach and Extension Activities by**
   - Providing technical coordination and logistical support to projects selected under Asia Pacific Partnership and leverage ECO-III's on the ground presence to make a higher impact;
   - Arranging study tour of Indian stakeholders to facilitate better understanding of business and operational structure of 2-3 energy efficiency centres in US

5. **Assist in the development of framework for energy efficiency risk financing by**
   - Identifying barriers to financing of energy efficiency projects in buildings, municipalities, and SMEs;
   - Working with financial institutions to streamline loan application, evaluation, and approval for energy efficiency to support implementation of pilot projects in the above sectors.

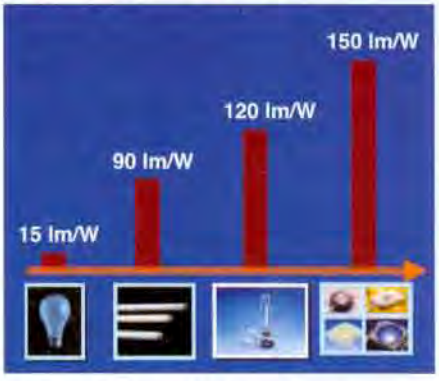
of the Bureau of Energy Efficiency (BEE). Support to BEE was provided to set up procedures and authorities, establish office facilities and assist in several activities leading to the development of BEE's Action Plan including thrust area such as the development of an energy auditor certification program.

ECO-II provided BEE with necessary technical assistance and training support to implement portions of its Action Plan in two of its thrust areas. First was to develop the Energy Conservation Building Codes (ECBC) for the five climate zones of India, and the second was to support Maharashtra Energy Development Agency in developing strategies for energy conservation and implementation of selected programs in the state.

Ongoing ECO-III Program's activities are aligned with BEE's focus areas as proposed in the 11th Five year Plan. The focus is on developing institutional capacity at the state level by working with energy development agencies and continue to work on developing the implementation framework for energy efficiency in the buildings (new and existing) and the municipal sector. Mandatory enforcement of ECBC will require fundamental changes in the way commercial buildings are being designed and constructed vis-a-vis building's envelope, lighting, and HVAC system.

International Resource Group (IRG) and its partners (IRG Systems South Asia, Alliance to Save Energy, DSCL Energy Services, National Productivity Council, Econoler International, Centre for Environmental Planning and Technology) are implementing ECO-III by working closely with international experts and the other organizations that are part of the ECO-III team.

T-5 Lamps in Mirror Optic Luminaire




Lighting Efficacy of Different Lamps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